

Effect of Treadmill Exercise on Nitric Oxide in Hypertensive Women

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ABSTRACT

Back ground: Shear stress on endothelial cells is a potent stimulus for Nitric oxide (NO) production, which is an important vasodilator. Exercise was associated with a significant reduction in mean systolic and diastolic blood pressure. **Purpose of study:** to study the effect of moderate exercises on the level of nitric oxides in hypertensive menopause women. **Method:** Thirty females with post menopausal hypertension with their ages ranged between 50-65years were divided into two equal groups: Group (A): females receiving suitable anti-hypertensive drug & subjected to an exercise program and then the level of nitric oxide was measured before & after the exercises for 30min. for 3days/week for 3months. Group (B): females receiving suitable hypertensive drug without being subjected to any exercise program & also the level of nitric oxide was measured before & after the administration of the anti-hypertensive drug. **Results:** Group (A) showed significant increase in levels of nitric oxide with significant decrease in blood pressure & body mass index more than those of Group (B) (that showed significant increase in levels of nitric oxide & significant decrease in blood pressure but of lower rates than those of Group (A)). **Conclusion:** the exercises performed with moderate intensity for three months were certain beneficial in increasing the level of nitric oxide and decreasing the level of mild hypertension in female patients.

Key word: Nitric oxides- Treadmill -mild hypertension

INTRODUCTION

Cardiovascular diseases are the leading cause of death in women and claim the lives of more than half a million women every year. Hypertension is one of the most prevalent and powerful contributors to atherosclerotic cardiovascular disease, affects more men than women until 55 years of age, but after age 55, the percentage of women is higher. Estrogen deficiency has been linked to the rapid increase in cardiovascular

disease in women who have undergone natural or surgical menopause.¹ Endothelium produces numerous substances, including nitric oxide (NO), which helps maintain the health of the vascular wall and regulate vasomotor function. Nitric oxide (NO) is a lipid soluble gas synthesized in endothelial cells from the amino-acid L-arginine through the action of endothelial nitric oxide synthase (eNOS). It is released both basally and in response to pharmacological stimulation.²The

possibility that NO may contribute to exercise hyperemia, as exercise is associated with increased pulse pressure and that repeated exposure to increased shear stress, as a result of exercise training, may improve the bioavailability of NO.² Aerobic exercise was associated with a significant reduction in mean systolic and diastolic blood pressure in hypertensive participants and normotensive participants and in overweight participants and normal-weight participants. An increase in aerobic physical activity should be considered an important component of lifestyle modification for prevention and treatment of high blood pressure.³ In 13 sedentary postmenopausal women, the blood pressure (BP), cardiac output, total peripheral resistance and calf vascular resistance and Flow Mediated Vasodilatation (FMD) were measured during baseline rest and again commencing 45 min after treadmill exercise. The results showed by falls in systolic BP and diastolic BP in postmenopausal women.⁴ Chronic intake of diets rich in pomace olive oil improves endothelial dysfunction by mechanisms associated with enhanced eNOS expression.⁵

AIM OF THE WORK

The purpose of this study is to investigate the effect of moderate exercise on nitric oxide in post menopausal hypertensive women to improve the flow mediated vasodilatation.

SUBJECTS & METHODS

SUBJECTS

Thirty female with post menopausal hypertension with ages ranges between 50 to 65years were included in this study, they were divided into 2groups ,Group (A) 15 females subjected to regular moderate exercise with medical treatment for hypertension, Group (B) 15 females was not subjected to the exercise program, they only received medical treatment for hypertension, none of them was diabetic or receiving any hormonal therapy but all of them were receiving the suitable anti-hypertensive drug combined with reduced Sodium intake.

The following parameters were done, e.g. height measured, body mass index calculated, blood pressure & heart rate measured and in addition to laboratory investigation for blood analysis (to measure the level of NO mainly). All these data were recorded in the data sheet for every subject.

Materials

A-Assessment Instrumentation

1. Power Walker (treadmill)
2. Analysing chemicals & commercial kits (R&D system, total Nitic oxide kit), to measure level of nitric oxide in blood samples.

Procedure

The subjects were divided into two equal groups; study group (Group "A") and control group (Group "B"). The training program for 12 weeks, 3times/week for 36 sessions, 30 minutes for each session & this training was only applied by the subjects of Group A.

Group A:

Each female were informed about the usage and the aim of regular moderate exercises with receiving the medical treatment without cut.

The aerobic training session include:-

Warm up 5 min – walking on treadmill with low speed, 20 min walking exercise ,with high speed and 5 min cooling down, low speed. The heart rate was recorded during the exercise training.

The moderate exercise parameter:

Duration: 30 min (five min warm up, twenty min active phase and five min cooling down).

Group B:

Each female in this group had not been participating in exercises

program, only receiving the medical treatment.

RESULTS

Data concerning each patient in the two groups were collected in the beginning of the study to determine the systolic and diastolic blood pressure and level of nitrite in plasma. These data were also collected after 12 weeks from both groups at the end of exercises evaluation.

The collected data were statistically analyzed using “ Paired T test “ to show the mean values and standard deviation before and after the treatment programs.

Group A:

Table (1): Mean \pm SD of Systolic & Diastolic blood pressure in addition to Nitric Oxide and Body Mass Index for Group A:

	Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)		Nitric oxide (μ mo/L)		Body mass index(kg/m ²)	
	Pre training	post training	Pre training	post training	Pre training	post training	Pre training	post training
Mean & SD	149.3 \pm 7.9	127.00 \pm 10.1	94.66 \pm 5.16	87.00 \pm 5.78	24.33 \pm 1.98	31.46 \pm 2.5	35.5 \pm 5.95	33.57 \pm 5.1
T-value	11.49		4.39		-17.79		6.5	
p	.001*		.001*		0.00*		0.00*	
Ratio of: (decline / increase)	16% (decline)		9%(decline)		23% (increase)		8% (decline)	

*: Significant

Group B:**Table (2): Mean \pm SD OF Systolic & Diastolic blood pressure in addition to Nitric Oxide and Body Mass Index for Group B:**

	Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)		Nitric oxide (μ mo/L)		Body mass index(kg/m ²)	
	Pre training	post training	Pre training	post training	Pre training	post training	Pre training	post training
Mean & SD	152.66 \pm 7.98	146.00 \pm 8.7	95.33 \pm 5.16	94.00 \pm 5.78	23.53 \pm 1.35	25.8 \pm 2.04	33.96 \pm 7.46	33.96 \pm 7.46
T-value	6.3		2.25		-4.9			
p	.001*		.04*		0.001*		0.00	
Ratio of: (decline / increase)	4% (decline)		3%(decline)		9% (increase)		No change	

* : significant

In this sample of postmenopausal women with predominantly mild hypertension, 3 months of supervised exercise training produced an excellent training response, including increase of nitric oxides synthesis level with reduced their SBP and DBP statistically significantly higher in (Group A) than (Group B) who received the hypertension medication only.

Table (3): Comparison between both groups before and after the study

variable	Study (GI)	Percentage %	Control (GII)	Percentage %
Nitric oxide (μ mo/L)	Increased From 24.33 \pm 1.98 To 31.46 \pm 2.5	23%	Increased From 23.53 \pm 1.35 To 25.8 \pm 2.04	9%
SBP (mmHg)	Decreased From 149.3 \pm 7.9 to 127.0 \pm 10	16%	Decreased From 152.66 \pm 7.98 to 146.00 \pm 8.7	4%
DBP (mmHg)	Decreased From 94.66 \pm 5.16 To 87.00 \pm 5.78	9%	Decreased From 95.33 \pm 5.16 To 94.00 \pm 5.07	3%
Body mass index(kg/m ²)	Decreased From 35.5 \pm 5.95 To 33.57 \pm 5.1	8%	No change 33.96 \pm 7.46	-----

DISCUSSION

In this study, the efficacy of regular physical activity in the form of moderate exercise training in postmenopausal hypertensive women, increase the basal level of nitric oxide and decrease the level of hypertension. Moreover, abnormalities associated with high BP, such as insulin resistance and hyperlipidemia, may persist or may even be exacerbated by some anti-hypertensive medications. After menopause, the incidence of hypertension increases in women to levels that equal or exceed that in men, suggesting a protective role of female sex hormones. ⁶ estradiol deficiency tends to have a negative influence on NO-cGMP pathway in menopausal women, thus modification in lifestyle by physical exercise is an important approach to prevent cardiovascular complications in this population ⁷ Endothelial dysfunction is one of the earliest markers of vascular abnormalities observed in cardiovascular disease and aging. Exercise training is an efficient therapeutic strategy to improve endothelial function. Related effects on vascular adaptations are primarily focused on vasodilator substances (i.e. nitric oxide). The Individuals with initially impaired endothelial function at baseline appear to be more responsive to exercise training than healthy individuals; so, it is more difficult to improve already normal vascular function. In thirteen sedentary hypertensive patients subjected to 60 min of training activity (exercise group), predominantly aerobic, three times a

week for a period of 12 weeks. Six sedentary hypertensive patients participated in the control group. After 12 weeks, l-arginine transport was significantly increased and associated with increased platelet NO synthase activity and cGMP levels and reduced platelet aggregation. Moreover, exercise training reduced plasma concentrations of fibrinogen and C-reactive protein and blood pressure. The control group did not change their previous intraplatelet l-arginine-NO results and systemic inflammatory markers levels. Thus, exercise training reduces inflammatory responses, restores NO synthesis in platelets and thereby contributes to the beneficial effects of exercise in hypertension ⁸ The plasma NO concentration measured before and after an aerobic exercise training regimen (cycling on a leg ergo- meter at 80% ventilator threshold for 30 min, 5 days/week) for 3 months in elderly women. Nitrate/nitrite levels were measured in hypertensive postmenopausal women. There was considerable increase in plasma nitrite/nitrate concentration (approximately 60%) as compared to studies where the physical exercise was applied for only 12 weeks with increment of 15-35% in plasma nitrite/nitrate concentration and the blood pressure at rest significantly decreased after exercise training. ⁹ Exercise has been implicated as an important factor in the up-regulation of both endothelial nitric oxide (NO) syntheses (eNOS) and neuronal NOS (nNOS) ¹⁰. Short-term exercise training enhances eNOS, and NO production and bioactivity, producing a short-term buffer to the increased shear associated with exercise. After

extended training, at least in the peripheral circulation, the increased production of NO and possibly other mediators induces structural changes in the vessels resulting in an increase in lumen diameter. Shear stress is hence 'structurally' normalized and endothelial NO activity returns towards initial levels.¹¹ The increase in blood flow, and change in Homodynamic that occur during acute exercise may therefore, provide a stimulus for both acute and chronic changes in vascular function. Not only as a localized phenomenon in the active muscle group, but also as a systemic response when a relatively large mass of muscle is activated regularly during an exercise training programmed.¹² During exercise, blood flow increases leading to higher intraluminal forces, which stimulates the release of vasodilating factors such as nitric oxide (NO) and prostacyclin by the endothelium.¹³ There was a significant effect of endothelial production of nitric oxide (nitrogen monoxide, NO) has become a major research area in vascular biology. Some of the most important effects that NO exerts in the vascular wall are potentially vasoprotective, because these effects maintain important physiological functions such as vasodilatation, anticoagulation, leucocytes adhesion, smooth muscle proliferation, and the anti-oxidative capacity.¹⁴ Aerobic exercise training induces numerous beneficial structural and regulatory adaptations in the cardiovascular system. Neural mediated adjustments in the heart underlie an important part of changes and lead to both

sympathetic inhibition and enhanced vagal activity.¹⁵

CONCLUSION

The result of this study, showed that endothelium NO synthesis increased in study group and the control group by different means (5.67) but in favor of the study group. Using a paired T test showed a significant change from rest (24.33 ± 1.98) to exercises (31.46 ± 2.5) ($\mu\text{mo/L}$) by 23%, of study group and it is increased to control group from (23.53 ± 1.35) to (25.8 ± 2.04), by 9%. This level of exercises showed in study group that both SBP and DBP decreased, in SBP decreased from 149.3 ± 7.9 to 127.10 (mmHg) by 16% while in control group SBP decreased from 152.66 ± 7.98 to 146.00 ± 8.7 (mmHg) by 4%, While DBP in study group decreased from 94.66 ± 5.16 to 87.00 ± 5.78 (mmHg) by 9% while in control group DBP decreased from 95.33 ± 5.16 to 94.00 ± 5.07 (mmHg), by 3%. So we conclude that walking daily for 20 min is essential to maintain the level of nitric oxide and prevents any progression of hypertension.

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تأثير تمرين السير الكهربائي على أكسيد النيتريك في ارتفاع ضغط دم السيدات

الهدف من هذه الدراسة هو دراسة تأثير تمرين السير الكهربائي على زيادة معدل أكسيد النيتريك في الدم عند مريضات ضغط الدم المرتفع وذلك بعد انقطاع الطمس بعام على الاقل ولا يخضعن للعلاج الهرموني حيث تتراوح اعمارهن ما بين (٥٠-٦٥ عام)، وقد تم اجراء هذه الدراسة على ٣٠ سيدة تم اخضاعهن الى مجموعة من القياسات وهي: ضغط الدم و الوزن و نسبة اكسيد النيتريك بالدم ، ثم تم تقسيمهن الى مجموعتين متساويتين: المجموعة (أ) حيث تلقت علاج دوائي لضغط الدم بالاضافة الى برنامج تدريبي على السير الكهربائي لمدة ٣ شهور بمعدل ٣٦ جلسة (مدة الجلسة ٣٠ دقيقة) ثلاث مرات اسبوعيا ، المجموعة (ب) حيث تلقت علاج دوائي فقط لمدة ٣ شهور ، ثم أجريت اعادة للقياسات السالفة الذكر لكلتا المجموعتين وقد أظهرت النتائج التالية: المجموعة (أ) أظهرت زيادة ملحوظة في معدل أكسيد النيتريك (من (٩ ، ١ ± ٢٤.٣٣) الى (٥ ، ٢ ± ٤٦ ، ٣١) ميكرومول / لتر) بنسبة ٢٣% بالاضافة الى انخفاض ضغط الدم و نقص الوزن مقارنة بالمجموعة (ب) والتي أظهرت زيادة في معدل أكسيد النيتريك ((١، ٣ ± ٢٣.٥٣) الى (٢، ٨ ± ٢٥) ميكرومول/لتر) بنسبة ٩% . وتوصى الدراسة بممارسة التمرين التدريبي مع العلاج الدوائي الذي قد يساعد في خفض جرعة العلاج الدوائي أو عدم زيادتها.